- **ENGINEERING MATERIALS:**
- a. **Pig Iron**: -product of the blast furnace and the basis of all ferrous metals, used for the manufacture of cast iron, carbon steel and alloy steels. never used as a structural material. It is weak and brittle, easily broken with a sudden blow; this is due to the presence of 4% carbon,
- **Wrough Iron**: - pure iron left after the removal of carbon. Its ferrite content is about 99.95%, the remaining 0.05% consisting of slag inclusions picked up during the smelting process carried out in a pudding furnace. It is a soft yet tough metal, easily bent or twisted while cold, yet king excellent resistance to corrosion is very good owing to the formation of film / scale of iron oxide which tends to prevent further oxidation / scaling.

- c. **Grey Cast Iron**: -Reheating of pig iron refines it to produce this iron provided the resulting liquid, cast iron, is allowed to cool slowly. It contains 3½% carbon, and the pressure at this carbon gives great fluidity to the molten cast iron, allowing it to be poured into sand moulds to produce castings. N/B wrough iron does not contain carbon, and even when heated it does not become liquid and cannot be poured into a mould. Because of the carbon presence as graphite this iron cannot stand up to sudden blows. Although this graphite promotes a very good low-friction bearing surface.
- **White Cast Iron**: - If liquid cast iron is rapidly cooled or chilled it resulted to a very hard cast iron which could not be machined using ordinary tools; (cannot be filed or turned on a lathe). Engineers has little use for this iron except when certain parts of a casting are required to be dead hard.
- **Carbon Steel**: - Carbon steels are made in steelmaking furnaces, where very careful control over the carbon percentage is maintained. Rounded the carbon does not exceed 1 1½% it combines chemically with ferrite, producing a very strong structure. The percentage of Carbon determines the type of carbon steel.

- **Alloy Steel:** - These are used when carbon steels are unsuitable for the kind of conditions to which the component will be subjected. For example, if a very strong steel is required, a nicked-chrome steel is much stronger than a plain carbon steel; if the component is required to resist corrosion, or in other words to be 'stainless', an alloy steel is used. They are also very suitable for making the wide range of cutting tools required to machine metals at high speed. The addition of metals such as Chromium, nickel, cobalt molybdenum and vanadium increases a plain carbon steel into an alloy steel.

- **Non-Ferrous Metals**: -They are much weaker than ferrous metals. However, they have a great advantage over most ferrous metals, such as their resistance to corrosion, from figure 2 non-ferrous metals divided into 2 groups.
- **Pure metals** – single metal
- **Non-ferrous alloys** – 2 or more metals e.g. nickel- chrome, brass (copper & zinc)
- **Pure Non-Ferrous Metals**
- (i) **Copper** – attractive red colour, soft and excellent conductor of heat and electricity
- (ii) **Tin** – Silvery in colour, soft, excellent resistance to corrosion, most expensive metal, seldom used in its pure state except as a protective coating for mild-steel sheet. So-called 'tin' cans are made from this sheet, known as tinplate, which has a very thin layer of tin on the surface.
- (iii) **Lead** – Silvery also in co lour, good resister of corrosion, easily cold worked (easily bent, twisted or hammered into shape with little risk of fracture or cracking.
- (iv) **Zinc** - Also silvery, easily bent and hammered into shape. Its excellent resistance to corrosion makes it suitable for covering mild-steel sheet, producing the easily recognized corrugated sheets.

(v) **Aluminum** - Silvery, 1/3 weight of steel, very soft when in its pure state, easily rolled into very thin sheet or foil. Most protective coverings for chocolates and cigarettes are made from aluminum foil.

Non Ferrous Alloys – All the pure metals given above posses very little strength; they are used, mainly because of the ease with which they can be worked, or because of their excellent resistance to corrosion.

(i) **Bronze** – Dark red-brown colour, an alloy of copper and tin. The amount of tin added to copper seldom exceeds 15%, thus copper is the parent metal. Bronze was highly prized in previous civilizations, finding extensive use engineering field is restricted, as it is now mainly a decorative metal, although with the addition of small amounts of phosphorus a very useful beaming metal is produced. Bronze has very good resistance to corrosion.

(ii) **Brass** – Addition of Zinc to Copper gives brass. Several types of brass are in use depending on the amount of Zinc added to Copper colour ranging from a rich gold to a light yellow. All brasses have a good resistance to corrosion.

(iii) **Duralumin** – It is a strong, light metal having a strength much superior to that of pure aluminum, and the metal had a close resemblance to aluminum, being silvery in colour.